Blended Learning as a Conduit for Inquiry-based Instruction, Active Learning, Formative Assessment and its Impact on Students' Learning Outcomes in Higher Education

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ABSTRACT

There is a definite impact of inquiry-based instruction, active learning and formative assessment on students' learning outcomes because all of these factors have the tendency to drive student's motivation, interest and performance in learning, especially when it is grounded in the use of the Blended Learning (BL) method. In view of this, the study attempted to identify the effect of these factor(s) on students' learning outcomes such as self interest, self efficacy and cognitive development. This study employed a quantitative method and a 5 point Likert scale survey instrument was used to gauge the response from students at the Faculty of Education in a public university. A total of 500 questionnaires were distributed and about 80% were returned from 444 student respondents. BL based formative assessment was found to be a strong contributor to the variance in learning outcomes, in higher education. The study indicated that a student's interest, cognitive development and self efficacy were influenced by many factors however, providing them with BL based active learning opportunities were extremely fruitful. In addition, inquiry based instruction and formative performance assessment are known as outstanding methods in recent years that have produced a shift in the focus of students' attention particularly towards learning in tertiary institutions.

Keywords: Blended Learning, Inquiry-based Instruction, Active Learning, Formative Assessment, Learning Outcomes, Higher Education

I INTRODUCTION

Globalisation and internationalisation has served as a catalyst for the transformation of higher education all around the globe including Malaysia. It was against this backdrop, that the Malaysian Ministry of Higher Education had (MOHE) launched the National Higher Education Strategic Plan (NHESP) which laid the foundation for the transformation of higher education in Malaysia. One of the main initiatives under the Malaysian NHESP is the development of quality human capital through a holistic approach that cuts across all disciplines and focuses on communication and entrepreneurial skills. Under the NHESP, the teaching and learning pillar encourages the use of a dynamic and market relevant curriculum that makes use of BL as a conduit for transforming the existing pedagogy.

This is deemed a necessary part of the transformation as close to 31,000 Malaysian university graduates were unemployed during the last quarter of 2006 (Morshidi et al., 2008) and the numbers have been adding up over the years. Among the main reasons cited for graduate unemployment were limited English Language proficiency, poor communication skills, inability of graduates to apply their knowledge in the work environment and a mismatch between university curricular and market demands (Morshidi et al., 2008). Thus, the NHESP had proposed that university curricula be reviewed to ensure it stimulates creativity, innovation, leadership and entrepreneurship alongside the utilisation of technology as a conduit. Besides that, there is a call for "peer review and industry collaboration for curricular development and evaluation" so that universities can equip their undergraduates with appropriate skills to compete in the ever-changing market (Ministry of Higher Education, 2007:27). In fact, NHESP has pointed out the importance of improving the teaching and learning aspect in higher education in Malaysia. Furthermore, there has been a call for a shift in the mode of presentation to an affective rather than a cognitive approach. Going hand-in-hand with this paradigm shift in holistic teaching and learning is assessment; an important aspect of pedagogy. The NHESP also provides systematic diffusion of knowledge through methodically selected pedagogic tools. It is also empowered by nationalistic ideals, principles and philosophy. In relation to this the National Educational Blueprint 2013 has outlined the importance of online learning in the national educational curriculum.

II LITERATURE REVIEW

Numerous studies have revealed the positive effect of inquiry-based instruction on teaching and learning (Avery & Meyer, 2012; Marshall & Horton, 2011). For example, a study by Wang, Wu, Yu and Lin (2015) has shown that there was an increased level of learning motivation and interest after implementing inquiry-based instruction in science subject. The study by Wang and Wu (2008) also revealed that inquiry-based instruction had a very significant effect on students' cognitive ability, students' interest, attitude toward science, skills domain, self efficacy, and performance-goal orientation. Meanwhile, Ali (2014) had also revealed a significant difference in mean scores of students who been taught using inquiry-based instruction.

On the other hand, Bransford, Brown & Cocking (1999), found that active learning allows learners control over their own learning and shape their cognitive, motivational and emotional learning processes that support self-regulated learning. A study by Gao and Hargis (2010) also found that active learning could promote and improve students' interest in learning. In their study among computer science students, they found that students who were engaged in the active learning process were able to identify their creativity through various class

activities that later improved their self-awareness and self-confidence. According to Solberg et al. (1993) self-efficacy has increased students' confidence in doing academic tasks such as reading textbooks, asking questions in class and preparing for exam. Furthermore a study by Chan et al. (2015) among 461 students (diploma, undergraduate and postgraduate) at the Faculty of Education in a public university in Malaysia reveals a moderate, positive and very significant relationship between "learning obligation (active learning's dimension)" and self efficacy ($r=.433$, $p<.01$) of the students. They also discovered a moderate, positive and very significant relationship between "collaboration in learning (active learning's dimension)" and self efficacy ($r=.496$, $p<.01$) and a weak, positive and significant relationship between "learning effort (active learning's dimension)" and self efficacy ($r=.343$, $p<.01$) of the students. They then further investigated the constructs using multiple regression to confirm the significant contribution of "learning obligation" and "collaboration in learning" towards the enhancement of self efficacy among students in higher education. Freeman et al. (2014) in their meta-analyses study also found that active learning increases undergraduates' performance ($r=9.781$, $p<.001$) in science, engineering and mathematics compared to traditional lecturing. They reported an improvement by 6% in average examination scores in active learning and showed the impact of active learning on student mastery of higher-versus-lower level of cognitive skills.

Furthermore, Black and William (2009) portray the importance of formative assessment in triggering student learning gains. In fact, formative assessment enables both instructors and students to work consistently in the zone of proximal development (Heritage, 2010). Heritage (2010) uncovered the importance of feedback on motivation and self-efficacy which is in parallel to a study conducted by Dweck (1999). Dweck studied performance-oriented students and she found that incrementally intelligent students regard errors as a new source of learning. The feedback from formative assessment inherently supports the incremental view of learning and the student stance of pro-active self efficacy connected with it. High levels of self-efficacious students are found where feedback on initial success is significant to potential ability (Swann, Pelham & Chidester, 1988) in learning. Besides that, a study conducted by Hwang and Chang (2011) posit that formative assessment has a positive effect on fifth grade students' learning interest and attitude, as well as their achievement. They managed to show significant improvement of the experimental group's result both in learning interest and learning attitude after the students participated in the learning activity. This result indicates that the formative assessment approaches improved students' interest as well as their attitude towards learning the course content (Hwang & Chang, 2011).

Researchers also believe that inquiry-based instruction leads to the execution of active learning because it augments an individual's interest with the study. Felder and Brent (2009) further claimed that active learning can also be obtained through formative assessment because this evaluation leads to active teaching. Furthermore, the work of Felder and Brent (2003) specified that active learning expands the situational interest of students which later results in improved interest and persistence in academics. The review above provides a strong case for active learning in improving students' attitude and performance. The study of Rotgans (2014) also stated that students' interest is strongly influenced through numerous factors, however providing them with the active learning opportunities is extremely fruitful. In addition, Beach and Myers (2001) explained that inquiry based instruction and formative performance assessment are known as an outstanding feature of studies in recent years that has produced a shift in the focus of students' attention, particularly towards enhancing approaches in learning and education. As noted by the above mentioned researchers, the instructors' pedagogical approaches and techniques affect students' cognitive ability that indirectly affects students' performance.

BL has been characterized as a teaching and learning model that combines both traditional classroom approach with an e-learning approach. BL can likewise be described as the integration of e-learning tools in a virtual learning environment with the conventional learning environment. BL has not only combined different media but also emphasised on the significance of the students learning outcomes when planning, creating and delivering BL. Some of the earliest studies refer to BL as a separate subdivision of the E-learning domain. While contemporary studies refer to BL as a fastidious mix of conventional and online learning experience (Garrison D. R., 2008). Tapsir (2016) notes that by 2025, 70% of the learning mode in higher education would be changed to BL.

III RESEARCH METHODOLOGY

The study was conducted at the Faculty of Education of a public university in Malaysia. A total of 100 diploma, 250 undergraduates and 150 postgraduate students from the Faculty of Education had responded to the questionnaires. Cluster sampling was chosen because it was much cheaper and more convenient to sample the population in a cluster rather than random sampling (Fraenkel et al., 2012).

The study utilised a descriptive-correlation research design to identify the relationship between independent variables of teaching, blended learning and assessment practices with the dependent variable of learning outcomes. Figure 1 shows the relationship between the independent and dependent variables in the study. The independent variables were the factors that the researchers intended to study in order to evaluate the possible effect on the dependent variable (Fraenkel et al., 2012). Therefore, the researchers assumed that the independent variables are contributing variables that have an effect on the dependent variable. The independent variables in this study were inquiry-based instruction, active learning and formative assessment presented through BL, while the dependent variables were situational interest, self-efficacy and cognitive development which form the students' learning outcomes. According to the research framework stated above, the researcher assumes that blended inquiry-based instruction, active learning and formative performance-based assessment would have an effect on

students' learning outcomes, in specific, situational interest, self-efficacy and cognitive development.

Data collection through questionnaires were done at the end of the semester, in specific after their paper and pen exams. During the semester assignments, quizzes and test which form part of their formative assessment package was conducted through the attendant and ubiquitous university Learning Management System (LMS).

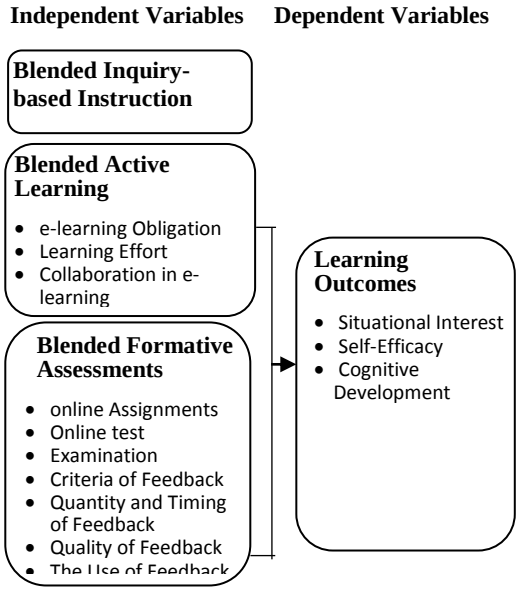

Figure 1. Conceptual Framework of the Study

Projects and assignments also involved the use of web 2.0 applications. Apart from the assessment 50% of the in class activities also involved using the universities LMS, MOOC's and web 2.0 applications. For instance one group of students undertaking a TESL programme at the undergraduate level had to make a recording of their sonnet recitation. This was uploaded to YouTube and the YouTube clip was linked to a mashable application (e.g Blendspace, Prezi, Wallwisher) which combined among other things their interpretation of the sonnet. In-class presentation and discussion was done using the application. Feedback was provided through the LMS as well as in class.

IV FINDINGS

Out of 500 survey questionnaires that were distributed to students at the Faculty of Education UiTM, 444 were returned with complete answers yielding a response rate of 88.8%. A majority (79.1%) of the respondents were females and only 20.9% were males. Based on ethnicity, Malays formed the majority of the respondents (96.2%, n=427). This was followed by other ethnicities, 1.8% (n=8), Iban 1.1% (n=5) and the least were Kadazans 0.9% (n=4). All of the respondents were Malaysian citizens. In terms of age, the students' were ranged from 18 to 49 years old throughout the undergraduate and postgraduate programs. The highest percentage of age distribution of students at the Faculty were 21-25 years old, yielding 57.4% as the majority (n=255). The second highest average age of respondents was 20 and below (26%, n=115). Age ranged from 36-40 and; 41 and above were the least age of respondents, yielding only 1.1% respectively.

Further analysis was conducted to identify any significant predictors of independent variables (blended inquiry-based teaching instruction, active learning, formative assessment, gender and programs) to students' learning outcomes in terms of situational interest, self-efficacy and cognitive development. Five independent variables namely inquiry-based teaching instruction, active learning, formative assessment, gender and programs; were entered into a multiple regression model to identify their contribution to the dependent variable of students' learning outcomes in higher education. The multiple regression model for this study was proposed as follow:

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e \quad \text{(equation 1)}$$

Where,

Y = Students' learning outcome (situational interest, self-efficacy, cognitive development) (dependent variable)
a = regression constant
β_1 = standardised beta coefficient for inquiry-based instruction
X_1 = inquiry-based instruction
β_2 = standardised beta coefficient for active learning
X_2 = active learning
β_3 = standardised beta coefficient for formative assessment
X_3 = formative assessment
β_4 = standardised beta coefficient for gender
X_4 = gender
β_5 = standardised beta coefficient for program of study
X_5 = program of study
e = random error

Table 1. Multiple regressions to determine predictors for students' learning outcomes (students' situational interest, self efficacy and cognition development) in higher education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.504	.254	.249	.23382

a. Predictors: (Constant), FA, IBI, AL
b. Dependent Variable: Students' Learning Outcome (Situational Interest, Self Efficacy, Cognitive Development)

Table 2. ANOVA analysis of the variables

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.186	3	2.729	49.914	.000
	Residual	24.055	440	.055		
	Total	32.241	443			

a. Dependent Variable: Learning Outcome (Situational Interest, Self Efficacy, Cognitive Development)
d. Predictors: (Constant), FA, IBI, AL

Table 3. Coefficients of the variables

Variables	Unstandardized Coefficients		Std Coefs		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.359	.135		10.034	.000
FA	.271	.042	.309	6.455	.000
IBI	.155	.041	.166	3.785	.000
AL	.117	.032	.174	3.628	.000
Gender	.010			.230	.818
Program of Study	.002			.053	.958

The ANOVA result ($F=49.914$, $p<.01$) further confirmed the significant contribution of "Blended Inquiry-based Instruction", "Blended Active Learning", and "Blended Formative Assessment" towards the "Students' Learning Outcomes" in higher education. Table 3 shows that blended inquiry-based instruction, X_1 ($t=3.785$, $p=.000$), blended active learning, X_2 ($t=3.628$, $p=.000$) and blended formative assessment, X_3 ($t=7.720$, $p=.000$) have significantly contributed to the variance of students' learning outcomes which consist of three dimensions namely situational interest, self-efficacy and cognitive development. However, the other two independent predictors were found to have no significant contribution to the variance of students' learning outcomes in higher education. These two factors were gender, X_4 ($t=.230$, $p>.01$) and program of study, X_5 ($t=.053$, $p>.01$). Therefore, only the independent predictors of blended inquiry-based instruction, blended active learning and blended formative performance-based assessment were reliably predicting the dependent variable of students' learning outcomes.

Based on the magnitude of the standardised beta coefficient, the reported values depict that formative assessment has contributed most strongly to the variance of students' learning outcomes in higher education with the highest standardised beta coefficient value ($\beta=.309$), followed by active learning ($\beta=.174$), inquiry-based instruction ($\beta=.166$), gender ($\beta=.010$) and lastly, programs of study ($\beta=.002$). Thus the final estimated multiple regression equation was presented as below:

$$Y = 1.359 + .309X_1 + .174X_2 + .166X_3 + e \quad \text{(equation 2)}$$

Table 1 also presented the value of R^2 and adjusted R^2. The R^2 was .254 and adjusted R^2 was .249. These figures indicated that only 25.4% (based on R^2) or 24.9% (based on adjusted R^2) of the total variances of the learning outcomes of students' situational interest, students' self-efficacy and students' cognition development in higher education were predicted by the practices of inquiry-based teaching instruction, active learning and formative assessment in higher education. Comparatively, the adjusted R^2 value provided a better estimation of the true population value. As a conclusion, the final estimated multiple regression model indicated that the three predictors of blended inquiry-based instruction, blended active learning and blended formative assessment have accounted for 24.9% of the explained adjusted variance in students' learning outcomes (situational interest, self-efficacy and cognitive development) in higher education.

V DISCUSSION

The findings from this study indicate that inquiry-based instruction, active learning and formative assessment carried out using a BL method were effective measures to enhance students' learning outcomes in higher education. In fact, the teaching and learning processes experienced by students are not only to improve their critical thinking, but also to enhance their ability to analyse and evaluate in the classroom (Chan et al., 2015). Inquiry-based instruction is part of active learning in which the students will engage in a quest, formulate and construct new understandings, meaning and knowledge; and share with others (Alvarado & Her, 2003). Hence, the findings of this study indicated that both the blended inquiry-based instruction and blended active learning were significant predictors for students' learning outcomes. Thus, inquiry-based instruction is designed for student-centred learning, and teachers play the role of learning drivers (White-Clark et al., 2008). Coupled with BL teachers become facilitators while students take charge of their learning.

Zulhamri et al. (2014) further posit that student-centred learning can be a medium to nurture students towards increasing their self efficacy as has been proven in this study. The findings of this study is also paralleled with a study by Gaffney et al. (2012) who states, elements related to active learning such as working in teams, doing activities and hands-on applications positively influence students' self-efficacy. Furthermore, Jungert & Rosander (2010) state that students' involvement in problem-based learning methods lead to higher self-efficacy because they have the opportunity to apply their knowledge on authentic and conceptualised problems, along with active communication with their peers. This approach uses both social and cognitive interactions. Besides that, the findings of this study also supported the findings by Greeno, Collins & Resnick (1996) who found that active learning elevates students' curiosity and motivation to explore their interests associated with the materials which espouse independent learning. Notably, inquiry-based instruction and active learning increases affective and cognitive outcomes (Herman & Knobloch, 2004) as have been reported in this study. As a result, students are motivated by blended inquiry learning because it permits active engagement in the learning process, especially in the process of finding the answers that motivate them to search for it. As a conclusion, blended inquiry-based instruction as a subset to blended active learning approach has a great impact on student engagement.

The multiple regression analysis in this study indicated that blended formative assessment as the major predictor to students' learning outcomes. This finding supports Tomlison (2008)'s argument that classroom assessment is helpful in monitoring student's learning progress and instructor(s) instruction improvement. Chan et al. (2011) in an earlier study had found that providing feedback to students, would help them to analyse and cope with their weaknesses and tackle the learning problem appropriately. This is in-line with a study by Light, Cox and Calkins (2009) where feedback was found to have significant importance, for example, helping students understand their mistakes and underlying causes of those mistakes, provide ways to improve learning, identifying

areas of achievement and providing students with professional and personal growth.

VI CONCLUSION

The significant relationship between inquiry-based instruction, active learning and formative assessment through a BL method and learning outcomes, warrants the development of a comprehensive system to moderate the cycle of teaching and learning in higher education. The findings of this study indicated that all the three aspects of inquiry-based instruction, active learning and formative assessment correlated positively and significantly with each other. These three aspects were also correlated positively and significantly with the learning outcomes of situational interest, self-efficacy and cognitive development. This implies that adding e-learning elements that contribute to active learning and formative assessment, enables students to experience improved levels of transformative learning.

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